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Averting maternal death and disability

## Recommendations for renovating an operating theater at an emergency obstetric care facility

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### Abstract

The importance of emergency obstetric care (EmOC) in reducing maternal mortality has focused attention on both the skills of the clinicians to provide high quality care and on the health facilities in which the care is provided. Essential elements of EmOC include the capacity to perform cesarean sections for which an operating theater is needed. This article focuses on renovation of existing operating theaters to meet the necessary standards. While building, adding to, or renovating operating theaters can be expensive, this article emphasizes appropriate materials that are likely to be locally available and relatively inexpensive. The importance of proper maintenance is discussed. © 2001 International Federation of Gynecology and Obstetrics. All rights reserved.

**Keywords:** Emergency obstetric care; Operating theater; Building materials for operating theaters; Organization of operating theaters

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## 1. Introduction

The operating theater (OT) is crucial to emergency obstetric care (EmOC). Many EmOC facilities, while improving their services, simultaneously direct efforts towards physical renovations of the OT. Planners are usually faced with limitations (financial resources, pre-existing space/layout, structural quality of the building, etc.) as they propose needed changes.

We will briefly explore the basic principles that support the successful functioning of the OT. The primary focus will be on some of the problems encountered in the renovation of the OT, as well as the approaches that planners can take in the renovation efforts. Although the discussions are specific to the OT, many basic concepts can be applied to other areas of the obstetric suite (such as the labor and delivery rooms).

Since what may be plentiful and easily attainable at one location may be too costly in another part of the world, there is no one solution. In light of this, planners are encouraged to use the best available local resources to upgrade the OT. The desired end result for all improvements is to provide the best possible environment and support to the OT as EmOC is enhanced to serve the community.

## 2. The ideal operating theater (OT)

The OT is the focal point of an EmOC facility. In the ideal situation, the obstetric OT should have a scrub area at the entrance and a nearby staff changing area. Also, the OT should be close to the labor room, delivery room, recovery room, dirty utility room, clean utility room (with autoclave), clean storage room and toilets/sinks.

This section will take a closer look at the OT in the ideal setting. Considerations in striving towards an ideal yet attainable OT will be discussed. In addition, some aspects of good maintenance and repair in the support of the OT will be reviewed.

### 2.1. Striving towards an ideal yet attainable OT

It is critical that all staff (doctors, nurses and support personnel) have a good understanding of the basic principles for 'in' and 'out' traffic of the OT (Fig. 1). In the ideal situation, the OT should be such that the 'clean' and the 'dirty' items do not cross paths. To best accomplish this, two distinct traffic patterns should be established. One traffic pattern should be dedicated to the two-way traffic flow (both 'in' and 'out') of patients, doctors and nurses. This route is also for clean items

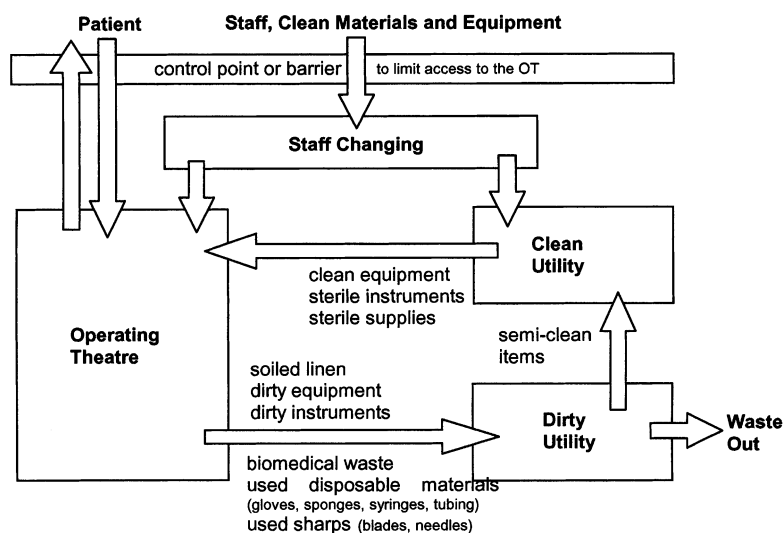


Fig. 1. Correct traffic flow in and out of the operating theatre.

(instruments, equipment, supplies, etc.) being moved into the OT. And the other traffic pattern from the OT should be for the removal of all used/dirty items (en route to being cleaned), used disposables (sponges, syringes, gloves, etc.) and biomedical wastes.

It is important that the OT area for EmOC should be separate from the areas where patients seek other forms of treatment at the facility [1]. A control point or barrier, created for example by a counter with a small pass-through window or a half door, helps establish a traffic pattern which will reduce the spread of infection into the OT area [2]. In this way, visitors would not gain entry and patients would remain within the clean area. Carts, equipment, etc., designated for EmOC should also remain within the EmOC area, decreasing the chance of contamination. Carts should be further identified as ‘clean carts’ for sterile supplies and instruments and ‘dirty carts’ for soiled linen, instruments, biomedical wastes, etc. [1].

## 2.2. *Clean and dirty utility areas servicing the OT*

It is very important that all items that come into contact with the patient are sterile and that after use, all of them are cleaned and re-sterilized, or disposed of safely. Ideally, the clean and dirty utility areas for processing items used in the OT should be separate rooms. Both the clean utility room and the dirty utility room should have a sink with drain and table space for organizing and drying items. And, these rooms should be used exclusively by the obstetric suite to reduce the risk of infection from patients being treated in other areas of the facility [1].

The dirty utility room should have enough work space to clean medical/surgical instruments and equipment, and conduct an initial decontamination by sterilization and disinfection [1]. It is important to have a deep sink in the dirty utility room so that all surfaces of items being cleaned can be easily washed with minimal splashing of contaminants. In addition, the sink should have a drain to carry off the contaminated flush waters to an appropriate enclosed disposal site. The dirty utility room should also have a direct route to the

waste collection or disposal site so that biomedical wastes and used disposable materials are not taken through ‘clean’ areas.

The clean utility room should have equipment for the final sterilization of medical/surgical equipment and supplies [1]. WHO stresses that the boiling or soaking of instruments in disinfectant solutions are not reliable means of sterilization. Steam under pressure (i.e. an autoclave) is the most common and desired form of sterilization [3].

## 2.3. *Storage areas for supplies specific to the OT*

Clean supplies (sheets, towels, bedpans, etc.) and sterile supplies (gloves, sponges, syringes, etc.) should not be stored in the same cabinet [2]. The need to gain access to clean items is more frequent than for sterilized items. By providing separate storage areas, the possibility of damaging sterilized packets (and therefore exposing the contents to dust and microorganisms) is reduced. Also, clean supplies and sterile supplies should not be in locations which increase the risk of contamination, such as next to the scrub sink. Storage rooms should be located within the obstetric suite.

It is important that all drugs are easily accessible to the OT and stored appropriately as specified by the manufacturer. For best results and to ensure maximum effectiveness, drugs are stored under specific conditions. The proper storage for some drugs is a dry, clean place at room temperature. For other drugs, the proper storage is at a constant temperature in a refrigerator or freezer. The storage units should function properly and maintain the required temperatures at all times. Note that a brief power outage resulting in a rise in temperature in the case of a refrigerator or the thawing of contents for a freezer, could lead to the breakdown of a drug and loss of its potency. It is important that all stored drugs are labeled clearly with an expiration date and are used before that expiration date to avoid loss of the drug’s effectiveness. In addition, accurate records should be kept as to amounts received and dispensed [3].

Safety measures should be taken for the storage

of materials in order to avoid explosions, fires and toxic fumes [3]. For example, gas cylinders should be strapped or chained to a wall or firm surface to prevent accidental dropping. Glutaraldehyde containing solutions, which are commonly used in the cold chemical sterilization process, should be stored in closed containers in a well-ventilated space.

#### *2.4. Good maintenance and repair in the support of the OT*

WHO stresses the following [3]:

- repairs to buildings and equipment should be done in a timely fashion;
- preventative maintenance eventually justifies the costs; and
- senior staff should inspect for maintenance up-keep.

Attention should immediately be given to faulty design/workmanship. For example, sloping floors towards the toilet fittings can easily fix toilets that stand in pools of water [4].

### **3. Renovating an existing operating theater (OT)**

In general, with renovations and additions to any existing space, planners should strive to make use of the best local resources and technology available to them. Also, cost-effective measures in the utilization and maintenance of the space should be explored [3].

There may be many obstacles in running a successfully functioning OT at an EmOC facility [2–4]. Some common occurring problems are listed below:

- equipment acquired without adequate technical support/training;
- dampness and deterioration of buildings caused by water leaks from improperly designed or maintained roofs and plumbing;
- dangerous electrical wiring;
- unsafe disposal of biomedical wastes;
- window configurations which do not allow patient privacy;

- space wasted by unnecessarily large lobbies or corridors and the storage of nonfunctioning equipment in usable rooms;
- wall and floor finishes which cannot be cleaned properly;
- insufficient toilet facilities; and
- inadequate water supplies.

Renovations addressing these and other problems as they relate to a successfully functioning obstetric OT will be discussed.

#### *3.1. Appropriate surface finishes and fittings for the OT*

It is important to note that the performance of a surface finish is only as good as the soundness of the construction to which it is applied. The best possible materials on a failing structure would not be cost effective. Furthermore, materials used in the renovation of the OT should be of good quality to endure daily washing with strong cleaning agents.

##### *3.1.1. Walls*

In the OT, the walls should be hard, non-porous, free of joints and crevices (which harbor dirt), easy to wash and withstand repeated contact with strong cleaning agents [2].

Dampness of walls or ceilings is often the result of a leaky roof or faulty plumbing. The source of the problem must be determined, appropriately corrected or repaired and sufficient time allowed for complete drying before the application of a surface finish [4]. For instance, a mosaic surface (with a cement mortar) on a wall constructed with mud mortar would almost certainly fail because a constantly wet mud base would collapse with the additional weight of the finishing surface [4].

*3.1.1.1. Mosaic.* A very good wall finish for the OT and other clean/wet areas is 'mosaic', also known as terrazzo or granolithic [4]. Mosaic is composed of stone chips set in a cement mortar matrix and ground to a smooth surface. It is recommended for walls and from the floor to 135 cm (4.5 feet). This surface finish and its height

provide additional protection to the walls of a typically small OT and allow for easy maintenance and cleaning.

**3.1.1.2. Ceramic tiles.** Walls with ceramic tiles are not recommended in the OT because the many joints are difficult to keep clean [4]. In addition, there are concerns about durability and resistance to wear. Ceramic tiles, however, are suitable for other areas such as the dirty utility room.

**3.1.1.3. Paint.** Not all kinds of paint are equally satisfactory. Laminated walls with three coats of polyethylene withstand wear and with an additional coat of epoxy paint, the problems of chipping, flaking or blistering are reduced [2]. Gloss or enamel oil-based paint can be used for areas of the wall from 135 cm (4.5 feet) above floor level to the ceiling in the OT and in other areas of the obstetric suite that are wiped periodically, but not washed frequently [4]. Although frequently used because it is inexpensive, limewash is not suitable for any wall surfaces in the obstetric suite, and in particular, this type of paint should not be used in the OT [4]. Limewash is water-soluble and therefore will dissolve when washed [4]. Cement paint also is not appropriate for any surface in the OT because its rough finish easily harbors dirt and therefore makes cleaning difficult [4].

### 3.1.2. Floors

The floors of the OT should be hard, seamless, easy to clean and able to withstand germicidal cleaning solutions [2]. Wooden and cement floors are not suitable in the OT because contaminants can easily collect in the pitted/cracked surface.

**3.1.2.1. Mosaic.** This is an excellent floor finish for the OT. See Section 3.1.1 on walls above. It is recommended that the mosaic floor slopes toward a drain outlet in one wall [4]. In this way, the floor can be easily kept clean.

**3.1.2.2. Vinyl.** A very hard vinyl floor covering on a concrete base is acceptable for the OT providing that the seams are heat-sealed and the vinyl adheres to the concrete by a non-water-soluble material [2]. However, this material should not be

used where there is the slightest suspicion of dampness within the underlying floor [4].

### 3.1.3. Ceilings

In the OT, as well as in the clean utility room, the ceilings should have a finish that reduces the possibility of contamination by falling particles [1]. An oil-based paint is recommended [4]. See Section 3.1.1 on walls above.

### 3.1.4. Doors

The doors of the OT are often of the swing type. The lifespan of the doors can be greatly increased by protecting the bottoms from constant wetting. An inexpensive and effective way is to bend a single thin aluminum sheet around the lower 150 mm (6 inches) of the faces, bottom edge, and side edges [4].

## 3.2. Equipment

The advantage of using standardized equipment is that issues of training, maintenance, spare parts supply and repair are minimized. WHO suggests [3] that equipment (whether obtained through direct purchase or as a gift) should be installed only if:

- there is a genuine need for the technology;
- there is a suitable site;
- all necessary services (electricity, water, etc.) are available;
- there is a warranty;
- the user's manual is in a language that can be understood by the users;
- spare parts and maintenance supplies are easily obtainable;
- consumable supplies are readily available and affordable;
- technicians are available to maintain the equipment; and
- staff will be trained how to use the equipment

Before any electrical equipment is plugged in, the socket and the wiring to it should be checked to confirm that: (a) there are no faults; (b) the electrical load of the equipment can be safely handled; and (c) the earth (ground) line is func-

tioning properly [4]. Voltage regulators should be considered for refrigerators and high power equipment.

When equipment is stored in a service area such as a corridor, it will collect contaminants. Such equipment should be wiped with a germicidal solution prior to moving into the delivery room or OT [2]. Electrical equipment should be unplugged when not in use to reduce potential damage by voltage surges [4].

### 3.3. Facility services supporting the OT

It is very important that there are adequate, safe and uninterrupted supplies of water and electricity to the operating suite.

#### 3.3.1. Water

Leaky plumbing (pipes/fixtures) as well as blocked sinks, drains, and toilets should be promptly repaired. There should be an adequate number of both handwashing sinks and deep utility sinks with drains. The plumbing pipes directing the waste water from the sinks should be of sufficient diameter to handle large, sudden volumes of water flushes during the cleaning process for instruments, linens, etc.

For areas around plumbing fixtures, the walls should be smooth and waterproof. Limewash, cement paint or gloss enamel paint should not be used around sink areas because the constant dampness would cause flaking, in turn exposing plaster and harboring dirt particles [4]. A splash-board of mosaic, smooth finish cement plaster, or waterproof paint is recommended around a sink or tap stand [4]. Wood is not a suitable material due to its progressive decay.

#### 3.3.2. Electricity

Electrical wiring should be designed and installed in accordance with relevant codes of practice. It is best to have the electrical wiring within the walls, where it is safe and does not collect dirt or interfere with cleaning. A less satisfactory alternative, but often the only choice in an existing building, is to hide wires inside a plastic, surface-mounted electrical ducting pipe [4]. Sockets and

switches should be housed in a standard grounded metal box, which is recessed into the wall and not on a wooden block.

#### 3.3.3. Back-up systems

It is important that there is absolutely no interruption with respect to lighting in the OT. A good back-up system is therefore needed during power fluctuations/outages.

A generator, located within the OT, provides a reasonable back-up power system as long as it has been housed and maintained properly. However, a wall or ceiling mounted battery-powered light unit may be a better solution for the OT. This back-up system does not require skilled maintenance and the batteries need to be replaced after 2–3 years. [4] The long-term availability and costs of fuel or batteries to run these systems are important considerations when choosing a back-up system for the OT.

#### 3.3.4. Where there is no back-up system

During power failures, the OT in some facilities may have no back-up system and rely on natural light. Under these circumstances, it is best to design the windows so that the lower ledge is just above eye level and thus providing privacy to the patient [4]. In the OT, window treatments such as curtains and screens should not be used because they gather dust and contaminants.

#### 3.3.5. Laundry

There are three types of laundry and they should be separated at the collection point [3]:

- linen soiled with use;
- linen contaminated with infective material; and
- staff work clothes.

It is good practice to have all gowns removed and deposited in a special container before personnel leave the OT [2]. It is recommended that they be laundered in machines if possible rather than by hand. Laundering involves a series of water flushes followed by detergent, chlorine solution and additional water rinses.

### 3.3.6. Housekeeping

The WHO stresses that cleanliness is very important. Cleaners should be given careful training so they understand the importance of their role/duties in the maintenance of a clean facility environment, one that could affect the outcome of a patient [3].

Cleaners should be provided with the proper tools — disinfectant detergents, mops with handles, mop buckets, rubber floor scrapers, steel wool or abrasive powder as well as gloves and boots [4]. There should be a housekeeping closet exclusively for the obstetric suite (and directly accessible from the suite) with a service sink plus storage space for housekeeping tools/supplies [1].

**3.3.6.1. Floors.** It is recommended that hard-surface floors be wet-mopped with a disinfectant solution between cases in the OT, and every several hours during the day in the corridors [2]. A good disinfectant is a 0.5% chlorine solution [5].

**3.3.6.2. All surfaces.** Walls, windows, doors, etc. should routinely be scrubbed to remove dirt. These surfaces should be wiped (starting from the top and working downward) with a disinfectant solution each day [5].

**3.3.6.3. Toilets.** Toilets should be maintained and kept clean with the use of a chlorine solution on a daily basis.

### 3.3.7. Biomedical waste disposal

All handling and disposing of instrument-washing solutions, suction bottle contents, human tissue, as well as contaminated disposable items (such as syringes, needles, etc.) should be done carefully and with the protection of gloves. WHO stresses that special care must be exercised in the disposal of wastes, whether by burning, burial or other means [3].

**3.3.7.1. Burning.** This is best done in an incinerator. However, wastes can be burned in an oil drum [5]. The site for burning wastes should be carefully chosen so that the fire can be safely confined and the smoke is downwind and does

not enter the building. The resulting ash can then be buried or thrown into a pit [5].

**3.3.7.2. Burying.** One possible solution is to construct an underground masonry chamber with a chute and capped lid to prevent the entrance of animals and vermin [4]. Unlike a fenced, open pit which requires covering with a layer of soil, the advantage of an underground masonry chamber is that the only actions required are the pouring of the waste down a chute and the replacing of the cap. With careful sorting, this is an easy and relatively inexpensive way to solve the biomedical waste disposal problem for several years.

## 4. Summary

The OT is essential to EmOC. Often as a medical facility upgrades its EmOC services, the existing OT undergoes renovations. Many problems are encountered in the process. This paper discusses the importance of:

- using appropriate materials in construction or renovation (surface finishes for the walls, floors and ceilings)
- establishing good maintenance practices (repair and preventative measures)
- providing continuous support services (water, electricity, laundry, housekeeping and biomedical waste disposal)

Some basic concepts for the successful functioning of an OT are reviewed and specific suggestions for its renovation are presented. An important underlying recommendation is that planners should use the best available local resources.

Improvements of the OT in an EmOC facility will improve staff morale and result in higher quality of service to the community.

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